Validation of a Combi Oven Cooking Method for Preparation of Chicken Breast Meat for Quality Assessment

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ABSTRACT: Quality assessment results of cooked meat can be significantly affected by sample preparation with different cooking techniques. A combi oven is a relatively new cooking technique in the U.S. market. However, there was a lack of published data about its effect on quality measurements of chicken meat. Broiler breast fillets deboned at 24-h postmortem were cooked with one of the 3 methods to the core temperature of 80 °C. Cooking methods were evaluated based on cooking operation requirements, sensory profiles, Warner–Bratzler (WB) shear and cooking loss. Our results show that the average cooking time for the combi oven was 17 min compared with 31 min for the commercial oven method and 16 min for the hot water method. The combi oven did not result in a significant difference in the WB shear force values, although the cooking loss of the combi oven samples was significantly lower than the commercial oven and hot water samples. Sensory profiles of the combi oven samples did not significantly differ from those of the commercial oven and hot water samples. These results demonstrate that combi oven cooking did not significantly affect sensory profiles and WB shear force measurements of chicken breast muscle compared to the other 2 cooking methods. The combi oven method appears to be an acceptable alternative for preparing chicken breast fillets in a quality assessment.

Keywords: chicken breast, combi oven, commercial oven, sensory descriptive profile, water cooking

Introduction

Quality assessment parameters of chicken meat, including sensory flavor and texture profiles, cooking loss / cooking yield and shear force, have been widely used in scientific studies to validate preprocessing treatments and postharvest processing technologies for chicken meat (Swatland 1999; Lyon and Lyon 2001). It has been demonstrated that these quality assessment parameters can be affected by cooking methods or techniques used for sample preparation. Lyon and Lyon (1993) found that a water-cooking method resulted in lower Warner–Bratzler (WB) shear values per cm^2 and lower intensity scores of sensory attributes of wetness and initial juiciness, but higher intensity scores of sensory attributes of bolus size and ease of swallow compared to a belt-grill oven cooking method for chicken breast meat deboned 2-h postmortem. For the samples deboned 24-h postmortem, the water cooking method resulted in reduced cooking yield, moisture, WB shear values per cm^2, and sensory wetness, initial juiciness, saliva produced and bolus wetness compared to the belt-grill oven cooking. Lyon and Lyon (1990a, 1990b) studied the effect of hot water cooking and microwave oven cooking on sensory and instrumental tests of broiler breast deboned 0-, 2-, 6-, and 24-h postmortem. In their 1st study, using descriptive texture profiling and texture profile analysis (TPA), they found that regardless of postmortem time, microwave oven cooked meat was profiled as wet-

ter, releasing more initial moisture during mastication and resulting in more mouth coating compared to the hot water-cooked meat. In their 2nd study, involving sensory tenderness measurements using an untrained panel and shearing tests, the microwave oven cooked meat had significantly lower WB shear values than the water-cooked meat. Rababah and others (2006) reported that chicken breast meats cooked by microwave had higher redness and lower lightness values than those cooked by a conventional electric oven. Also, meats cooked by microwave had higher WB maximum shear force and work of shearing, and higher TPA hardness, springiness, cohesiveness, and chewiness values than meats cooked by a conventional electric oven. Mickelberry and Stadelman (1962) cooked broiler halves using deep fat frying and steam precooking followed by deep fat frying. Lower cooking losses were recorded for the meat cooked by steam precooking followed by deep fat frying. Shear values were higher when the broiler breast was fried without precooking. Yingst (1970) cooked raw chicken in water or steam and found no difference in cooking loss between the 2 methods; however, steam cooking produced a tenderer product than water cooking as measured by the Allo–Kramer shear press.

A combi oven is a relatively new cooking technique in the U.S. market. It is a single piece of equipment that can replace cooking needs for a steamer, grill, and convection oven. A combi oven uses both moist and dry heat, either separately or in unison, to cook many different foods in a wide variety of ways. It gives good control of relative moisture and cooking climate by bridging the gap between broiler and broilerless technology with fewer maintenance issues such as de-liming, and lower operational costs through improved energy and water conservation. The benefits of combi cooking also include reduced cooking time, reduced cooking loss yielding a juicier product, uniform temperature throughout the cooking chamber (meaning more uniform cooking results), easy to operate

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and maintain, and preservation of food quality including nutrients, flavor, and looking (http://www.hennypenny.com, accessed Oct 2007). The combi oven has become more and more popular in foodservice; however, there was a lack of published data showing its effect on the parameters commonly measured in chicken breast meat quality assessment, such as sensory profiles, WB shear force, and cooking loss. The objective of this study was to assess the impact of a combi oven cooking method on cooking time–temperature profiles (or sample preparation requirements), WB shear force, cook loss, and sensory flavor and texture profiles as compared to a conventional commercial electric oven cooking method and a hot water cooking method commonly used in research.

Materials and Methods

Chicken samples

Ready-to-cook carcasses from approximately 6-wk-old broilers were obtained from a local processing plant immediately after the flow-through, paddle-type chiller. The carcasses were placed in a cooler and transported to the laboratory within 20 min (the temperature of carcasses was 3 to 4 °C on arrival). The individual carcasses were then randomly selected, assigned a bird number, weighed, placed in Ziploc freezer bags (Ziploc Brand Freezer Bags, Johnson & Son, Inc. Racine, Wis., U.S.A.), and stored at 2 °C for 22 h (24 h total) prior to deboning. After storage, breast fillets were removed, weighed and color and pH were measured. The average weight was 118 g (ranging from 97.3 to 151.4 g), the average L^* value was 61 (ranging from 54.2 to 73.1) and the average pH value was 5.8 (ranging from 5.65 to 5.94). The fillets were placed in a polymeric bag (Seal-a-Meal, The Holmes Group, El Paso, Tex., U.S.A.) labeled with bird number and side of carcass (left or right). Bags were vacuum sealed. As carcass/fillet sizes of chicken vary greatly, more carcasses/fillets were collected than needed for the study. After all fillets were weighed and bagged, the weight range was reduced by removing the smallest and largest fillets. For instance, in rep 1 the initial weight range of the fillets was 83.0 to 139.5. The largest and smallest fillets (and their matching right or left) were removed to reduce the variation in size to 97.3 to 128.9. To further avoid variation of fillet properties, the fillets from each carcass were assigned to 2 cooking methods. For example, the first 2 fillets (from carcass 1) in rep 1 were assigned to the conventional commercial electric oven and hot water cooking, the second to the combi oven and the hot water cooking and the third to the combi oven and the conventional commercial electric oven. Assignments continued in this fashion until all fillets were assigned to matching cooking methods. The assigned fillets were then refrigerated at 2 °C for 7 d before cooking.

Cooking

For the combi oven cooking, 10 vacuum bagged fillets (average fillet weight 117 g) were placed on metal half sheet pans (5 fillets/pan) and cooked in a Henny Penny MCS-6 combi oven (Henny Penny Corp. Eaton, Ohio, U.S.A., a representative of the most typical combi oven used in commercial operation products), with internal dimension 65 × 51 × 57 cm set at 85 °C and tender steam. For hot water cooking, 2 pots were used with samples in cooking bags hung on metal rods (5 fillets/pot with average fillet weight 119 g) and immersed in 7 L of hot water (targeted temperature 85 °C) in 11.4 L (12 qt) stainless steel stock pots (Revere Ware, Clinton, Ill., U.S.A.). The cooking pots were heated on an electric stove and water temperature was controlled manually by adjusting the heating control dials, adjusting lids on or off and by adding ice chips (Liu and others 2004). For

the conventional commercial electric oven cooking, chicken fillets (10 fillets with the average fillet weight 118 g) were removed from the packaging bags and placed in 2 glass 23 × 33 × 5 cm Pyrex baking dishes (5 fillets/dish) covered with aluminum foil. The samples were cooked in the preheated Vulcan electric (commercial) oven (Vulcan model E60F, Vulcan-Hart, Louisville, Ky., U.S.A., a representative of the most typical conventional oven used in commercial operation nowadays, with internal dimension 56 × 66 × 34 cm) set at 163 °C. For all cooking methods, when the core temperature (endpoint internal cooking temperature) reached 80 °C, the fillets were removed and allowed to rest at room temperature. After samples cooled to 76 °C, cooked samples were weighed for determining cooking loss and then slices were removed for the sensory panel and WB shear force measurements.

Temperature measurements

Temperature profiles of ovens/pots and the heaviest fillet per pan/pot were recorded using 12-channel Digi-sense scanning thermometer model 92000-00 (Barnant Co., Barrington, Ill., U.S.A.) and type T, copper constantan thermocouple wires with soldered ends and type K connectors (fabricated on site). Target cooking temperature was 80 °C. Endpoint temperatures were verified in the thickest part of each fillet with a handheld Digi-sense Dual J-T-E-K thermocouple thermometer model 9110-40 (Cole-Parmer Instrument, Co., Vernon Hills, Ill., U.S.A.) fitted with hypodermic needle microprobe MT-23/3 (Physitemp Instruments Inc., Clifton, N.J., U.S.A.).

Sampling for sensory evaluation and shear force measurement

Cooked breast fillets were removed from their bags, weighed, and sliced for sampling one at a time following a similar sampling scheme as outlined by Lyon and Lyon (1996). Two 1.9-cm-wide strips were removed from the breast by cutting next to a template aligned parallel to the muscle fibers and adjacent to the cranial end. One strip was used for instrumental evaluation. The 2nd strip was cut into 2 subsections (1.9 cm high × 1.9 cm wide) and used for the sensory evaluation. Each panelist received 2 subsections from a single breast piece in capped 4 ounce Styrofoam cups labeled with 3-digit blinding codes. The strips for instrumental evaluation were placed on a tray and covered with a double layer of polyethylene film and allowed to cool to room temperature before measurement.

Cooking loss and Warner–Bratzler shear force

Cooking loss was calculated by dividing the difference between raw fillet weight and cooked fillet weight by raw weight and multiplying by 100:

$$\text{Cooking Loss} = 100 \times (\text{Raw Weight} - \text{Cooked Weight})/\text{Raw Weight}.$$

For WB shear values, room temperature samples were sheared perpendicular to the longitudinal orientation of the muscle fibers using a TA-XT*Plus* Texture Analyzer (Stable Micro Systems, Surrey, U.K.) fitted with a 50 kg load cell and Texture Exponent 32 version 3,0,3,0 software. A TA-7 WB shear type blade was used. Test settings included a button type trigger, 55 mm travel distance, 4 mm/s test speed, and a calibration return distance of 1 mm. Maximum force measured to cut the strips (19 mm width) was expressed as kilograms. For each cooked fillet, 1 strip was sheared in 2 locations and heights of the fillets at each location were recorded. The average of the 2 maximum forces for each strip was used for data analysis (Lyon and others 2001).

Sensory evaluation

Samples were analyzed by the 9-member trained panel with 3 to 13 y of experience in descriptive analysis of chicken. The texture and flavor of the chicken breast fillets were profiled using a Spectrum™-like approach which involved the identification and use of clearly defined attributes, ratings on 0 to 15 linescales and use of universal references (Meilgaard and others 1991). A previously developed scoresheet was utilized that consisted of 18 texture and flavor attributes and definitions that are listed in the order of evaluation in Table 1. Six orientation and practice sessions were held to review attribute definitions, techniques and references. Panelists' performance was monitored and checked utilizing Senstools v. 3.1.6 software (OP & P Product Research, Utrecht, The Netherlands).

The sensory testing involved 3 replications and a randomized design. Each replication was 1 panel session and included samples from 9 breast fillets (1 fillet/panelist) for each of the 3 cooking methods. Within each day, all panelists received samples in the same order with a 20-min rest period between samples. Testing was done in individual booths under sodium vapor masking lights using computerized ballots generated with Compusense five version 4.6 software (Compusense, Inc., Guelph, ON, Canada). Filtered water and unsalted crackers were available to the panelists for mouth-cleansing between samples (Lyon and others 2001).

Statistical analysis

Both analysis of variance (ANOVA) and analysis of covariance (ANACOVA) of quality measurements were conducted using Gen-eral Linear Models procedure (GLM) (SAS version 9.1, SAS Inst. Inc., Cary, N.C., U.S.A.). The entire experiment was replicated 3 times with a total of 81 chicken fillets (27 fillets/cooking method). Because of the concerns about whether the uniformality of chicken breast weight, size, and surface area is really the same as the real application of these cooking techniques in sample preparation for quality assessment and the difficulty to find the chickens with the same breast weight, the ANACOVA was used to statistically control the potential effect of chicken fillet weight (covariate) on the testing results (even though the chicken breast weight was only roughly sorted by removing the lightest and heaviest ones). The purpose of the ANACOVA was to adjust the observations of the response variables (such as WB shear force, cooking loss, and sensory attributes) to the breast weight before comparing the means (Lentner and Bishop 1993). The statistical significance selected was P value $<$ 0.10 for the relationship between covariate chicken fillet weight and response variables, and slopes of regression lines or covariate slopes. P value < 0.05 was used to determine significance of main effects of cooking methods.

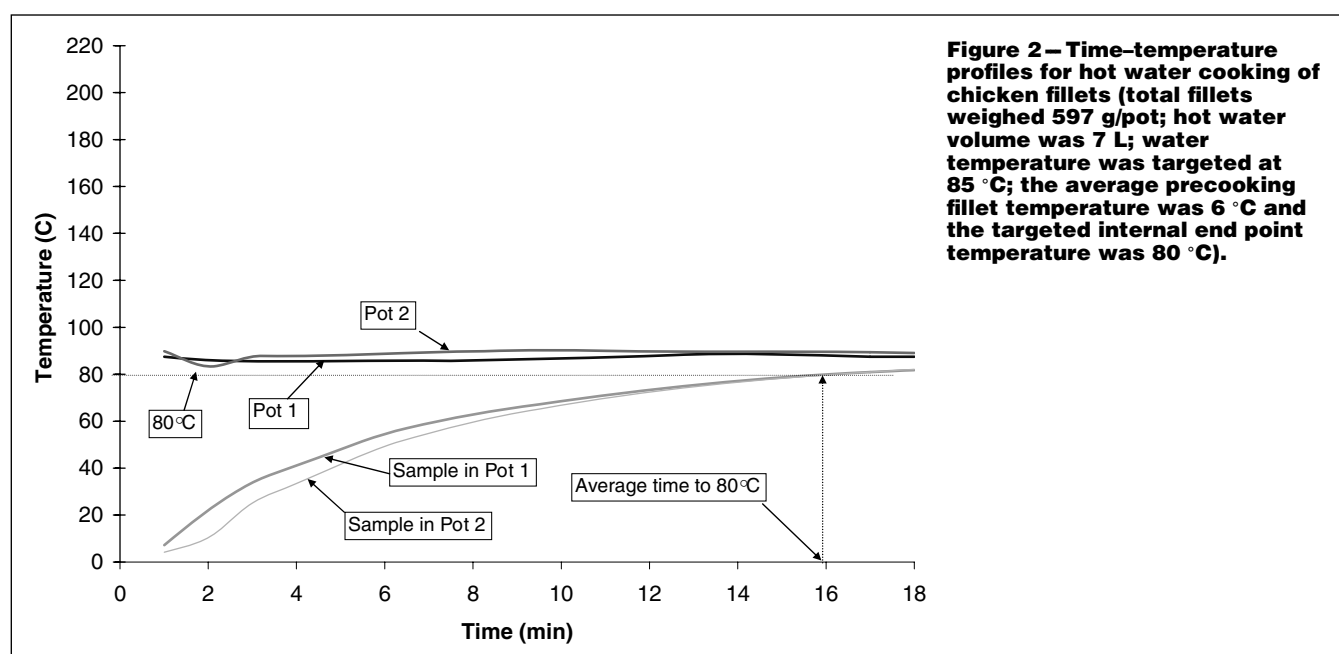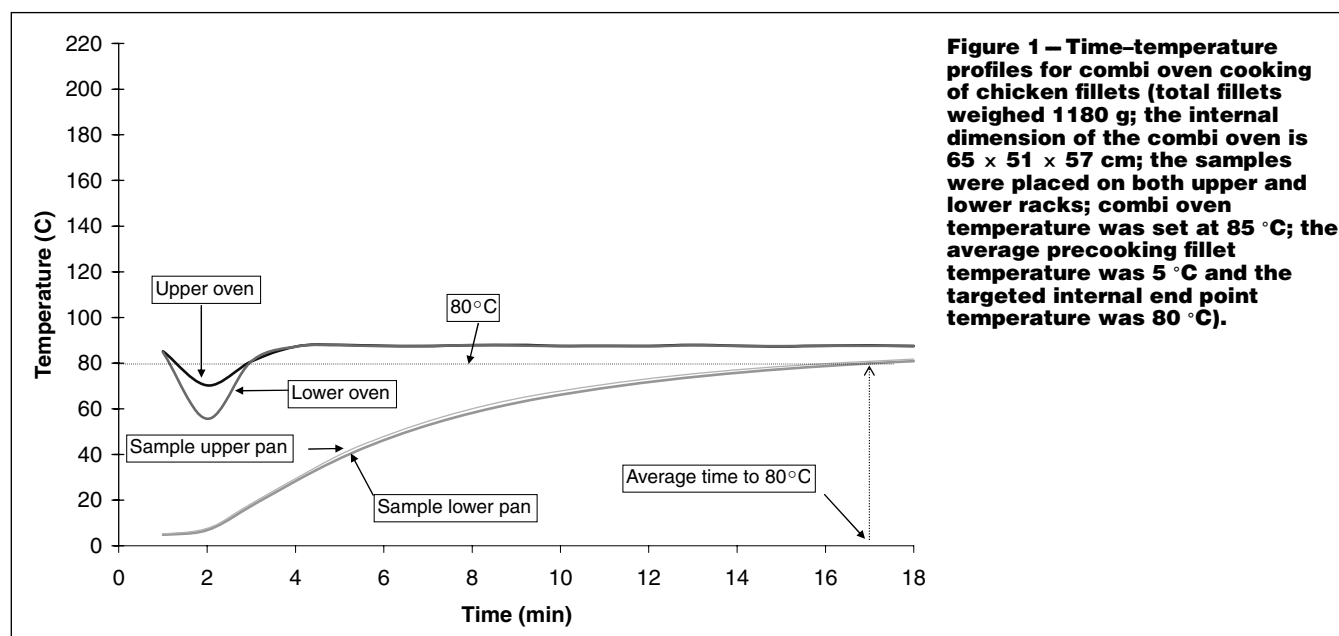## Results and Discussion

Cooking time–temperature profiles

The mean cooking time–temperature profiles of 3 cooking methods used in our study are presented in Figure 1, 2, and 3. The chicken fillets for the combi oven and hot water cooking were cooked in individual plastic cooking bags and the samples for the conventional commercial electric oven were cooked in glass pans covered with aluminum foil without the cooking bags. The average precooking internal temperature of chicken fillets was 5 to 6 °C and the targeted endpoint internal temperature or core temperature was 80 °C. For the combi oven (Figure 1), cooking temperature was set at 85 °C. The actual average recorded temperature was 86 °C with a range from 57 to 88 °C (including the initial temperature drop recorded at the early cooking stage due to opening the door). Except for a difference in temperature between the upper and the lower oven within the first 4 min of temperature equilibration, the average temperature of the upper and lower oven areas were exactly the same (87.6 ± 0.2 °C) during the following cooking period. It took an average of 17 min for the core temperature of chicken fillets to reach 80 °C. Average internal temperature after removal from the oven increased from 80 to 81 °C. This time–temperature profile demonstrates that a combi oven can control its internal oven temperature accurately, evenly and consistently, and can produce cooked samples for quality assessment in less than 20 min with an average 1 °C override. For the hot water cooking (Figure 2), the targeted water temperature was 85 °C and the actual average recorded temperature was 88 °C with a range from 83.4 to 90.2 °C. No significant disturbance was noticed at the early cooking stage like the combi oven when the sample was immersed in the hot water pots. There was a small difference (2 °C) in the average recorded cooking temperature between 2 pots used in our test (it was 88.9 °C for pot 2 and 86.9 °C for pot 1). It took 16 min for the core temperature to reach 80 °C and the average internal temperature after removal increased by 2 °C (the maximal temperature was 82 °C). In our hot water cooking, since we used an electric stove to heat water in a stainless pot similar to a cooking stove system at home (different from a well-controlled water bath system), it was labor-intensive and showed some variation in cooking temperature compared to the combi oven cooking (due to the requirement of continually adjusting the heating power or lids and adding ice cubes as needed during cooking). The operation requirement plus the time–temperature profile indicates that hot water

Table 1 – Sensory attributes and definitions used by descriptive analysis panel to evaluate test samples.

Attribute	Definition
Texture	
1. Springiness	Amount/degree the sample returns to its original shape after partial compression—1st bite
2. Cohesiveness	Distance you can bite into the sample before it breaks, cracks, crumbles—1st bite
3. Hardness	Force to compress the sample with the molars during first 2 bites
4. Moisture release/ juiciness	Amount of moisture coming from the sample during the first 5 chews
5. Wetness	Or wetness of wad, amount of moisture in the bolus
6. Particle size	Size of particles in the wad during chewdown
7. Bolus size	Maximum size of the wad
8. Chewiness	Amount of work to chew the sample to the point of swallow (or spit out)
9. Toothpack	Fibers stuck between teeth after swallow
10. Residual loose particles	Amount of small loose particles in mouth after swallow
Flavor	
Aromatics	Aromatic taste sensation associated with:
1. Brothy	Meat stock
2. Chickeny/Meaty	Cooked white or dark chicken muscle
3. Cardboardy	Cardboard, wet paper
4. Barnyard/Wet feathers	A chicken coop; combination of manure, moldy hay, feed and poultry odors including wet poultry feathers
5. Bloody/Serumy/ Metallic	Raw or 'rare' lean meat, blood, serum, or metal/iron
Basic tastes	Taste on the tongue stimulated by:
6. Sweet	Sugars and high potency sweeteners
7. Salty	Sodium salts, especially sodium chloride (table salt)
8. Sour	Acids

cooking used in our test requires more attention to achieve the consistency of cooking temperature control. Otherwise, it was basically similar to the combi oven cooking. Figure 3 shows the cooking time–temperature profile for the commercial electric oven used in our present study. Although the targeted cooking temperature was 163 °C as recommended by AMSA (1995), the overall recorded average cooking temperature was 186 °C, 23 °C above the target temperature. In addition, the cooking temperature of the upper rack area significantly differed from that of the lower rack area ($P < 0.01$). Even in the same location inside the oven the cooking temperature apparently underwent a cycle of 10 min and varied largely during cooking (overall range 49 °C). The actual average recorded temperature for the lower rack was 171 °C with a range from 131 to 187 °C and the average for the upper rack area was 201 °C (38 °C above the target) with a range from 173 to 215 °C. It took 31 min for the core

temperature to reach 80 °C. Average internal temperature after removal increased by 9 °C (89 °C). This result demonstrates that the control and consistency of cooking temperature in a conventional commercial oven could be an issue for sample preparation. A conventional commercial oven requires the knowledge (or calibration) of the difference between temperature setting and actual temperature, and heat distribution inside the oven before cooking to have a well-controlled sample preparation. Table 2 shows the comparison of cooking operation requirements for the 3 cooking methods based on our temperature profile study and operation experiences. The benefits of using a combi method include low-temperature cooking, uniform temperature throughout the cooking oven, short cooking time, minimized temperature override, hands-free cooking and better temperature control (more consistent with oven settings). From the operation point of view, a combi oven is a good

Figure 1 — Time–temperature profiles for combi oven cooking of chicken fillets (total fillets weighed 1180 g; the internal dimension of the combi oven is 65 × 51 × 57 cm; the samples were placed on both upper and lower racks; combi oven temperature was set at 85 °C; the average precooking fillet temperature was 5 °C and the targeted internal end point temperature was 80 °C).

Figure 2 — Time–temperature profiles for hot water cooking of chicken fillets (total fillets weighed 597 g/pot; hot water volume was 7 L; water temperature was targeted at 85 °C; the average precooking fillet temperature was 6 °C and the targeted internal end point temperature was 80 °C).

alternative for hot water cooking and commercial electric oven cooking in sample preparation for quality assessment of cooked meat.

Effect of chicken breast fillet weight on statistical analysis of cooking method effects

ANACOVA is a statistical procedure that allows you to include both categorical (such as cooking methods in our study) and continuous variables (weight and quality measurements of chicken fillets) in a single model. The main purpose of ANACOVA is statistical control of variability when experimental control cannot be used and it tests the main effect of the categorical variable by removing the effect of an extraneous variable (such as chicken fillet weight in present study) referred to as a covariate. In other words, the ANACOVA permits us to conduct an ANOVA after removing the influence of the covariate rather than on the original values themselves (so-called adjusted ANOVA). Three null hypotheses were tested in an ANACOVA. One is whether there is a linear relationship (or linear regression) between response variables (quality measurements) and the covariate (if there is no relationship between response variables and covariate or we have no evidence of a nonzero regression slope, we can use ANOVA to determine cooking method effects). If the above-mentioned hypothesis is not rejected (or if there is a linear relationship), another null hypothesis is tested: that the slopes of the regression lines (also called regression slopes) are all the same (if the slopes are not equal, there exists an interaction between covariate and treatments and we might make incorrect conclusions). If the hypothesis of the common slopes is not rejected, the 3rd null hypothesis is tested: that the means of response variables are all the same between treatments (adjusted ANOVA) (Lentner and Bishop 1993). Table 3 shows our ANACOVA results. A level of significance of 0.10 was used for relationship between the response variables and covariate (column 2) and homogeneity of regression slopes (column 3) to increase the power of the tests of significance. A level of significance of 0.05 was used for mean effects or adjusted ANOVA (column 4). For most quality parameters, there was no relationship (P value > 0.1) between the covariate, fillet weight, and response variables (individual quality measurements) except for cooking loss, WB shear force, wetness,

bolus size, and barnyard/wet feathers (see P value in column 2). This suggests that only these 5 parameters need to be further analyzed using ANACOVA, and the other parameters can be analyzed using an ANOVA model. Further analyses of covariate slopes (column 3) show that all P values were larger than 0.1, indicating that the common regression slope cannot be rejected for these 5 response variables and we can use ANACOVA to separate cooking method effect from the fillet weight effect. The last column of Table 3 shows the results of adjusted ANOVA, demonstrating that cooking methods had significant effects on only cooking loss among all the measured parameters after considering the effect of chicken fillet weights.

Effect of cooking methods on Warner–Bratzler shear and cook loss

Table 4 compares the effects of cooking methods on WB shear force values and cooking loss of 24-h deboned chicken fillets. The combi oven cooking did not result in significant changes in WB shear force values compared with the conventional commercial oven cooking and hot water cooking. Cooking loss for the commercial oven method was 7% and 5% higher than that for the combi oven and hot water cooking methods, respectively. There was also a significant difference (P value < 0.05) in cooking loss between

Table 2 – Comparison of operation requirements for 3 different cooking methods, a combi oven cooking method, a hot water cooking method, and a commercial oven cooking method.

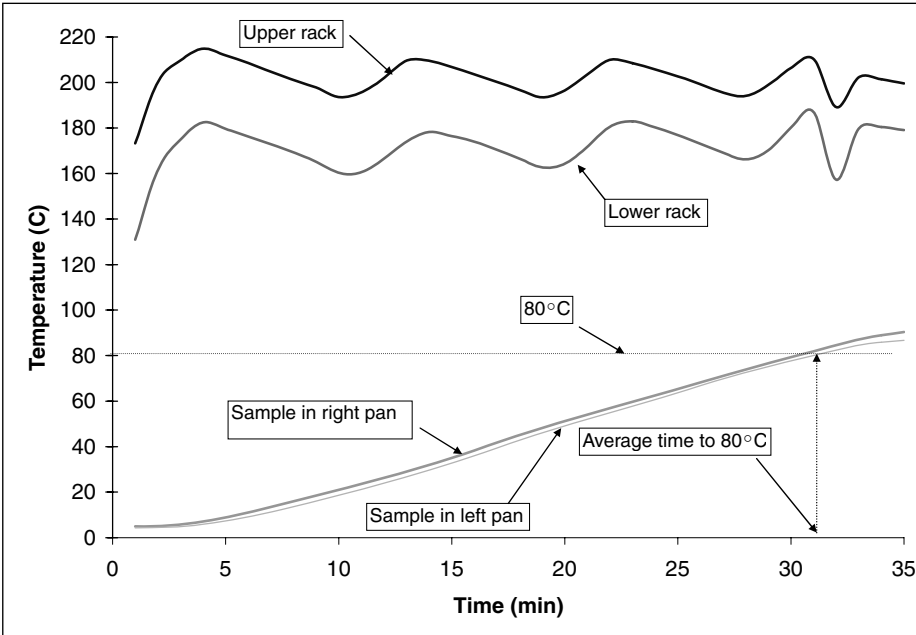|	Cooking method		
Requirement	Combi oven	Hot water	Commercial oven
Hands free cooking	Yes	No	Yes
Short cooking time	Yes	Yes	No
Low temperature cooking	Yes	Yes	No
Ability to use cooking bags	Yes	Yes	No
Consistent temperature throughout oven	Yes	Yes	No
Minimal temperature override	Yes	Yes	No

Figure 3 – Time–temperature profiles for Vulcan conventional commercial electric oven cooking of chicken fillets (total fillets weighed 1174 g; the internal dimension of the Vulcan E60F commercial electric oven is 56 × 66 × 34 cm; the distance between the sample rack and bottom was 19 cm, lower oven area; the oven temperature was set at 163 °C; the average precooking fillet temperature was 5 °C and the targeted internal end point temperature was 80 °C).

the combi oven and hot water cooking (1.6%). It has been demonstrated that cooking methods can result in changed WB shear values and cooking yield (or cooking loss) of chicken breast meat.

Table 3 — Statistical significance of ANACOVA (analysis of covariance) for relationship between covariate (chicken breast fillet weight) and response variables (quality and sensory parameters), regression slopes, and adjusted main (cooking method) effects.

Response variables	Relationship between covariate and responses	Regression slope	Adjusted ANOVA
	P value		
Cooking loss	0.06	0.30	< 0.01
WB shear force	0.02	0.14	0.45
Springiness	0.78	—	—
Cohesiveness	0.61	—	—
Hardness	0.69	—	—
Moisture release/ juiciness	0.30	—	—
Wetness	0.06	0.27	0.42
Particle size	0.21	—	—
Bolus size	<0.01	0.23	0.97
Chewiness	0.43	—	—
Toothpack	0.11	—	—
Residual loose particles	0.37	—	—
Brothy	0.83	—	—
Chickeny/Meaty	0.43	—	—
Cardboardy	0.28	—	—
Barnyard/Wet feathers	0.06	0.43	0.92
Bloody/Serumy/ Metallic	0.77	—	—
Sweet	0.22	—	—
Salty	0.35	—	—
Sour	0.35	—	—

Table 4 — Average Warner–Bratzler (WB) shear values and cooking loss of chicken breast fillets cooked with a combi oven, hot water, or commercial oven (mean ± SD).
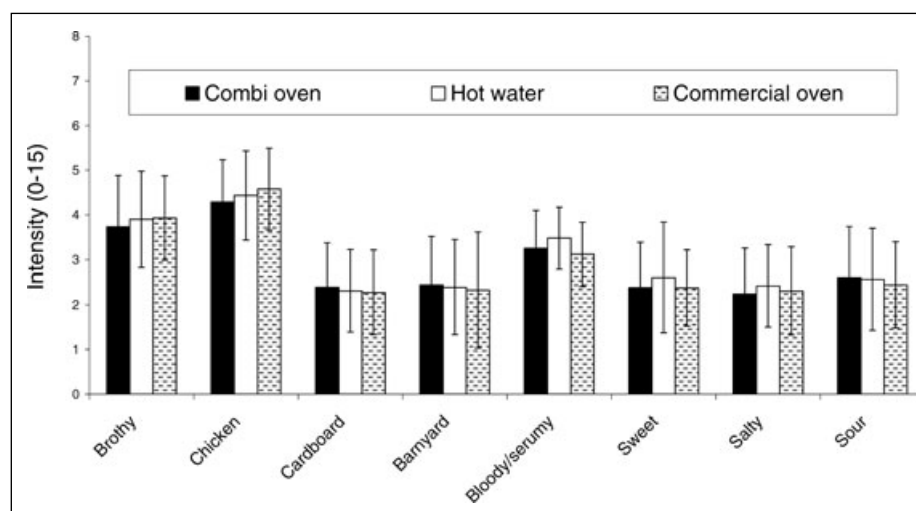
	Cooking method		
	Combi oven	Hot water cook	Commercial oven
WB force (kg/1.9 cm)	4.7 ± 1.2[a]	4.5 ± 1.1[a]	4.3 ± 1.1[a]
Cooking loss (%)	18.9 ± 2.5[c]	20.5 ± 3.0[b]	25.8 ± 2.4[a]

[abc]Mean values with no common superscript in the same row are significantly different from each other ($P < 0.05$).

Lyon and Wilson (1986) found that for both hot bone and 24-h deboned chicken breast meat, microwave oven heated samples required significantly reduced force to shear (WB) compared to the corresponding water-heated ones. Hot water cooked samples exhibited higher cooking yield (or lower cooking loss) than microwave cooked samples for hot bone samples; however, for 24-h deboned samples, the microwave-heated sample exhibited higher cooking yield than the water-cooked samples. Lyon and Lyon (1993) demonstrated that hot water cooking resulted in reduced cooking yield of 24-h deboned chicken breast meat compared to the belt-grill oven cooking; however, the belt-grill oven cooking resulted in significantly increased WB shear values per cm^2 of chicken breast meat compared with the hot water cooking regardless of deboning time. Lyon and Lyon (1990b) showed that the difference in the WB shear force of chicken breast meat between the 2 tested cooking methods (hot water and microwave oven) did not change much with postmortem aging; the hot water cooked samples showed higher WB shear values. Our results further demonstrate that cooking methods can significantly affect cooking loss (or yield) of chicken breast meat and also indicate that we can use combi oven cooking to prepare cooked chicken breast meat for WB shear measurement in place of hot water cooking and commercial oven cooking.

Effect of cooking methods on sensory flavor and texture profiles

Figure 4 and 5 show average intensity scores of sensory flavor and texture attributes of the cooked breast fillets. The average scores for both flavor and texture attributes were in the lower to middle portion of the 0 to 15 intensity scale. The average intensity scores of the flavor attributes were from 2.2 of salty taste to 4.6 of chicken/meaty flavor, and they ranged from 2.7 of toothpack to 5.3 of cohesiveness for the texture attributes. These results are in agreement with the previous findings reported in the literature. Liu and others (2004) reported that the average intensity scores of 8 sensory flavor attributes of 24-h deboned fillets ranged from 2.2 for salty taste to 4.1 for chickeny/meaty flavor and the maximum average intensity scores for 8 tested sensory texture attributes was ≤ 4.6. Lyon and others (2003) studied the effect of postmortem deboning time on the sensory profiles of hen breast meat using sensory attributes similar to ours and found that the maximum intensity scores were ≤ 4.2 for 8 chicken flavor attributes and the average scores ranged from 3.3 of bolus size to 5.2 of cohesiveness for 8 tested texture attributes of 24-h deboned hen breast. Our sensory evaluation

Figure 4 — Average intensity scores of sensory flavor attributes of chicken breast meat prepared by using 3 different cooking methods (mean ± SD).
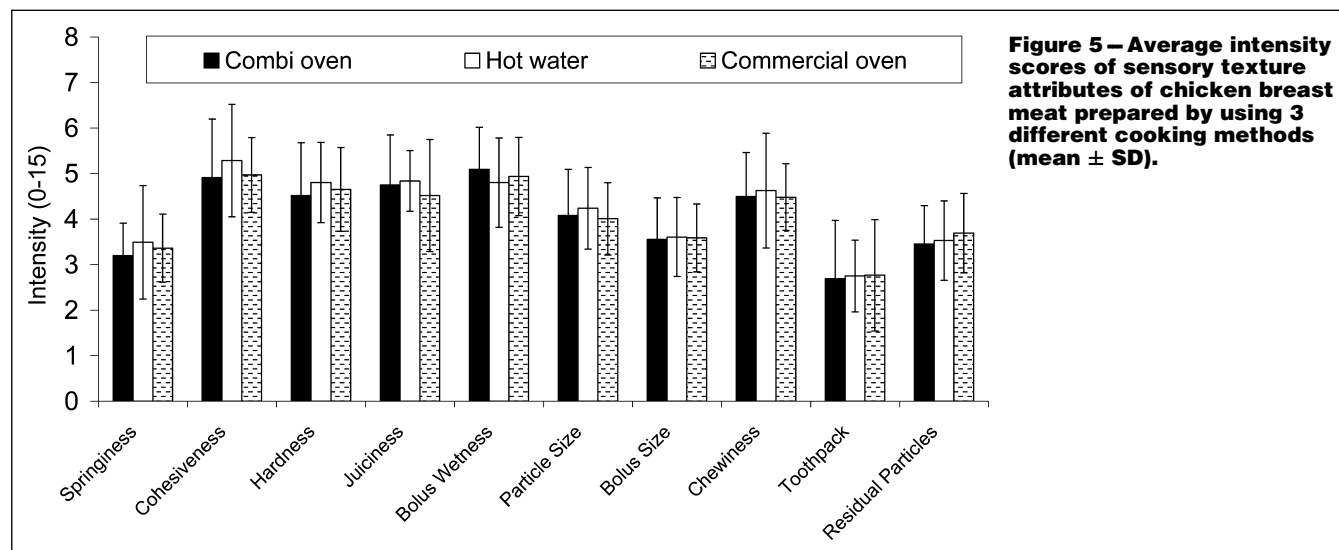
Figure 5 – Average intensity scores of sensory texture attributes of chicken breast meat prepared by using 3 different cooking methods (mean ± SD).

results indicate that the chicken breast meat used in our experiment had the typical sensory properties of deboned chicken breast meat. Figure 4 and 5 also demonstrate that there were no significant differences in intensity of all tested flavor and texture attributes across cooking methods ($P > 0.05$), suggesting that the combi oven cooking did not result in any significant changes in sensory flavor and texture profiles compared to the conventional commercial oven cooking and hot water cooking.

Conclusions

Our experiments demonstrated that combi oven cooking did not result in any significant changes in both WB shear force values and sensory flavor and texture profiles as compared with hot water cooking and conventional commercial electric oven cooking. A combi oven not only had the advantages that hot water cooking had, such as low-temperature cooking, short cooking time, consistent temperature control, ability to use cooking bags, and minimal temperature override, but also offered hands-free cooking (reducing human operation errors) compared to the hot water cooking method used in our study. Compared to conventional commercial electric oven cooking, our study results, consistent with the benefits claimed by the manufacturer, showed that a combi oven reduced cooking time, reduced cooking loss, and had uniform temperature throughout the cooking chamber. However, our study failed to demonstrate that the combi oven cooking could preserve flavor and yield a juicier product compared to the other 2 cooking methods tested in this study. A combi oven appears to be an alternative cooking method for preparation of chicken meat for both sensory and instrumental quality assessment.

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